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Partitioning of evaporation fluxes in summer and winter using stable isotope approach

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Irrigation is the largest user of fresh water in the world. Unfortunately a large part of irrigation is unsustainable and inefficiently causing water scarcity with sometimes terrible effects on the water cycle, ecology, economy and food production. The key in determining the efficiency of irrigation is to investigate how much irrigation water is indeed used by crops for transpiration. Only this part of the total evaporation is used by crops to produce biomass and can be seen as productive evaporation. To separate evaporation into the productive (transpiration) and non-productive (interception and soil evaporation) we use stable isotopes ^{2}H and ^{18}O. This research investigates the changes of isotopic composition of stable isotopes ^{2}H and ^{18}O in the soil over the year in a lysimeter setup in the Netherlands. When the water balance is combined with isotopic values, an isotope mass balance can be made. This is used to separate evaporation fluxes and makes it possible to determine the transpiration flux of vegetation. During a six month period (November 2010 to June 2011) values of stable isotopes ^{2}H and ^{18}O in a lysimeter covered with grass were monitored. Furthermore, during a two month period (May and June 2011) a second lysimeter without vegetation was monitored to find out what the effect is of vegetation on isotope composition. When comparing the lysimeter with and without grass cover, it was found that transpiration plays no role in the non-covered lysimeter. In the latter, higher enrichment of soil water was observed and the isotope regression line had a lower slope. Isotope composition changes during the year. In winter (November to February) soil evaporation and isotopic enrichment were low. In summer (April to June) soil evaporation and isotopic enrichment were high. This research shows that it is possible to separate evaporation into soil evaporation and transpiration. During cold the period (December to February) the amount of transpiration was relatively high (75.0 % - 90.5 %) , since only limited soil evaporation could take place. When less water was available during warm periods (April and May), the share of transpiration in the total evaporation term decreased (47.3% - 53.4 %).